

Table 19-1A

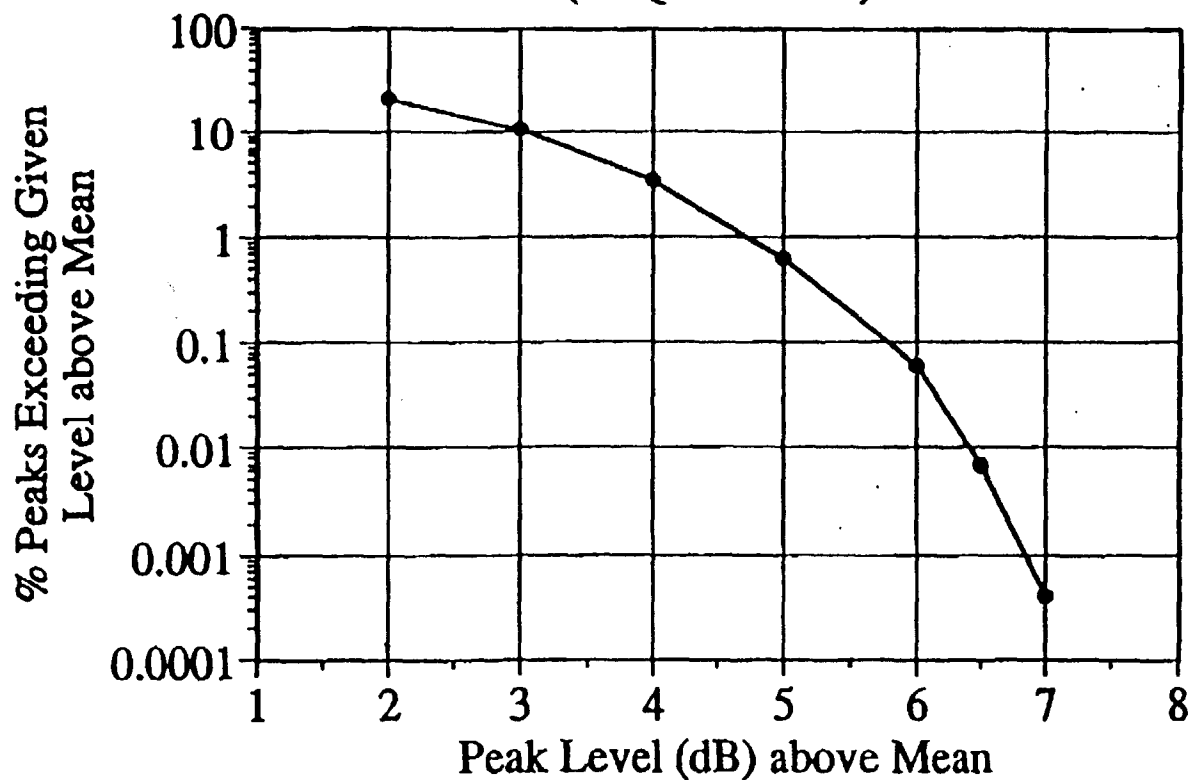
## Transient Peak Power - 32 QAM Mode

Peak Level Above Mean*	Meas. 1	Meas. 2	Meas. 3	Meas. 4	Meas. 5	Average	Percentage
Reference	10,278,955	10,278,958	10,278,955	10,278,955	10,278,955	10,278,955.2	100
+2 dB (-5.72 dBm)	2,147,354	2,158,072	2,158,589	2,158,325	2,161,308	2,155,929.6	20.98
+3 dB (-4.72 dBm)	1,087,993	1,090,132	1,091,153	1,089,529	1,089,339	1,089,629.2	10.60
+4 dB (-3.72 dBm)	359,244	362,116	361,903	360,988	363,598	361,569.4	3.52
+5 dB (-2.72 dBm)	61,380	62,132	62,640	62,305	62,663	62,212.0	.61
+6 dB (-1.72 dBm)	5,087	5,159	4,999	5,204	5,302	5,148.2	.06
+6.5 dB (-1.22 dBm)	708	676	628	631	733	675.0	.007
+7 dB (-0.72 dBm)	43	46	40	41	48	43.8	.0004
+7.5 dB (-0.22 dBm)	2	1	2	0	0	1.0	‡

\*Mean power level was measured as -7.72 dBm.

‡Statistically insignificant

# **DigiCipher** **Transient Peak Power Levels** **(32 QAM Mode)**



**Figure 19-3**

ATTC  
WES/TMG  
07/08/92

**DRAFT**

**FCC Advisory Committee on Advanced Television  
Service**

**Contribution to the Final Report  
of the Implementation Subcommittee**

from

**Working Party 2 on Transition Scenarios**

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## Executive Summary

IS/WP-2 was constituted to develop transition scenarios for the conversion to Advanced Television. In doing so, it sought to develop scenarios for each of the industry segments involved in the transition, to identify any potential differences in the implementations of the proposed systems, and to identify potential problems in the implementation of ATV.

Information was obtained through direct communications and surveys from proponents, professional and consumer equipment manufacturers, broadcasters, and experts in relevant industry sectors. The Working Party developed a series of PERT and Gantt charts and lists of underlying assumptions to serve as a reference for those tasked with implementing the ATV service.

The Working Party found that, in general, the time required to implement ATV is approximately the same for all industry sectors and for all proposed systems. The Working Party identified tasks on the critical path to implementation, first and foremost among which is the disclosure of and agreement on full technical details of the selected system sufficient to permit design and manufacture of integrated circuits and equipment for encoding, transmitting, receiving, and decoding ATV signals by parties other than the proponent.

IS/WP-2 identified the need for new towers in some locations, principally high population centers, as critical to the delivery of ATV to the largest proportion of the population of the United States. IS/WP-2 surveys indicate that, depending upon the exact power requirements of systems, between one-third and one-half of television stations will require new towers. On the other hand, IS/WP-2 found that, in the abstract, stations can implement ATV within the 5-year window established by the FCC. IS/WP-2 also found, however, that provision must be made in FCC procedures for those stations that, no matter how hard they try, will be precluded from implementing within the 5-year window by factors beyond their control. ~~Economics were not considered in any of these conclusions...~~

Expert input and a survey of all consumer manufacturers indicate that ATV receivers will be generally available in the marketplace 2—3 years following the unambiguous selection of a system. Transmitters and antennas will be available within the necessary time frame. A distributed (multiple transmitting sites sharing the same frequency) approach to transmission has been suggested, which may optimize coverage and use of spectrum.

Software producers and user were generally in agreement that sufficient software would be available by the time it is needed. There was a strong consensus on certain software quality characteristics, namely 16 X 9 aspect ratio, component operation, multi-channel (some said digital) audio, and improved resolution.

In summary, IS/WP-2 found that all of the elements would be available in time to meet the proposed timetable if the process proceeds as planned. However, some adjustment of the timetable by the FCC would be required in some cases where the timetable cannot be met due to events beyond the control of the licensees.

## I. Introduction

This Final Report of Implementation Subcommittee Working Party Two on Transition Scenarios represents the first extensive treatment of the concerted work of the members of the Working Party over a four year period. In particular, this document is the result of the tireless efforts of the following individuals, supported by their respective employers, constituted as a report-writing committee for IS/WP-2:

Larry Cochran	Thomson Consumer Electronics
David Folsom	
Charles Heuer	Zenith Electronics Corporation
James Kutzner	Public Broadcasting Service
Kenneth Skinner	Philips Laboratories
Craig Tanner	Cable Television Laboratories
S. Merrill Weiss	Consultant
Chuck Wilk	Corporation for Public Broadcasting

### A. Objectives of IS/WP-2

In carrying out its charter, as provided by the FCC in establishing the Advisory Committee, Implementation Subcommittee Working Party 2 on Transition Scenarios has three principal objectives. These are:

- (1) Development of transition scenarios for the industry segments involved in implementation of an Advanced Television (ATV) service. Implementation in this report means the development and construction of new equipment by manufacturers and the assembly and operation of facilities, all required to effectively delivery advanced television programming to the viewing public. The transition scenarios were developed are to be based on tasks required for implementation by the industry segments and estimates of the time and, for the broadcast industry, personnel resources required to complete the tasks.
- (2) Identification of differences in implementation between the proposed systems that may be relevant to the selection process and the forwarding of that information to the appropriate entities within the Advisory Committee. Any differences found were used to tailor transition scenarios to specific systems.
- (3) Identification of potential problems surrounding the implementation of Advanced Television, so that these can be brought to the attention of others within the Advisory Committee and to the FCC. When possible, solutions to the



problems raised were developed so that action can be taken in advance of the actual authorization of ATV service.

It should be noted that in examining the various aspects of the transition to ATV, IS/WP-2 gave no consideration to the financial resources required by the participants to carry out their respective implementations. Such matters are the responsibility of other groups within the Advisory Committee structure. Rather, it has been assumed that each of the implementers has the financial wherewithal to make the necessary changes and additions to its facilities.

#### B. Efforts Undertaken

A major part of the work undertaken by IS/WP-2 has been development of a series of charts of the implementation process for the various industry segments showing the tasks they must undertake, the relationships of those tasks, and the times likely to be taken in completing the tasks. Experts from each of the industry segments participated in the construction of the charts.

For example, IS/WP-2 has surveyed the owners of all major television station groups to determine their expectations for the implementation of ATV transmission systems. It has also surveyed the Chief Engineers of a sample of stations to determine the personnel resources each has and might make available to carry out the implementation. (It should be noted that the surveys were conducted prior to the First Notice of Proposed Rulemaking issued by the FCC on November 8, 1991. The potential impact of the regulatory incentive proposed in the First and Second Notices on the results of the surveys is discussed below.) In addition, IS/WP-2 instigated discussions among TV stations in some of the larger markets in order to understand the problems they may face and to give them a head start in addressing them.

In order to differentiate between implementation requirements and capabilities of the proposed systems, it was necessary to review IS/WP-2 implementation charts with the system proponents. Two meetings conducted with each to first inform them of the work of IS/WP-2 and then obtain inputs and responses to questions posed by the Working Party regarding the implementations of their respective systems.

## II. Transition Scenarios

In order to arrive at comprehensive scenarios for the transition ATV, IS/WP-2 broke down the industry into a number of segments for which individual scenarios portray the critical event required in order to implement the FCC's plan for ATV.

### A. Method

The mechanisms chosen for depicting the various transition scenarios are PERT and Gantt charts<sup>1</sup>. A critical path, displayed on either chart, locates activities critical to controlling the overall time of implementation. [See conclusions in Section VI.]

From these inputs, plus a list of assumptions made for the many activities, a series of generic (not system-specific) PERT and Gantt charts were created for each industry segment.

Industry segments included in these examinations are:

- Production/Post Production
- Networks
- Local Stations
- Transmitters
- Satellite Distribution
- Common Carrier Distribution
- Cable
- Consumer Products
- Transmitter and Antenna Manufacturers  
and Tower Erectors
- \*\*\*\*\*Other Professional Equipment Manufacturers

\*\*\*\*\*One significant unknown among the tasks in the transition scenarios for some of the industry segments is the time that will be required for the availability of professional equipment, other than transmitters, antennas, and towers, necessary to support the selected system. Early in its work effort, IS/WP-2 conducted a rudimentary survey of professional equipment manufacturers to ascertain their estimates on the availability of equipment. The response was too small to be statistically significant, and it became apparent that some of the responses were provided in an effort to influence the outcome of the study. Consequently the study was discounted as premature in

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<sup>1</sup> In a PERT chart, the tasks required to complete a project are arranged in a network in which the tasks are interconnected by virtue of their dependencies upon one another. The Gantt chart, on the other hand, shows the sequencing of activities in time.

further work of the committee. But the study did demonstrate in a qualitative way that the manufacturers would require considerably more information about the proposed systems before they could answer objectively about future equipment availability.

\*\*\*\*\*As a result, IS/WP-2 assumed the needed equipment would be available in sufficient quantity to meet the demand one year following the FCC's selection of a system. This assumption had little impact because this equipment is well off the critical path. [See conclusions, Critical Path Tasks.] When other, much shorter projections are made about the durations of the other tasks, however, the availability of professional equipment moves into the critical path.

#### B. Inputs From Proponents

\*\*\*\*\*[To be supplied]

### III. Surveys

IS/WP-2 conducted a number of surveys covering different target groups and different aspects of the transition. Some have been recorded in earlier Interim Reports, for example the survey of television stations regarding the availability of space for additional antennas on existing towers. The remaining, heretofore unreported surveys are reported in this section. [See Section V.].

#### A. Group Owners

*Facts & conclusions should be deleted from this section.*

A mail survey of TV station group owners was conducted during the summer of 1991 to gather information on current human and financial resources plus estimates of manpower that could be made available to supplement that currently available at their stations for a major design/construction project. Group owned stations includes those stations whose owners have controlling interest in two or more stations in different cities. In addition, information was sought on when the owners intended to implement ATV at their stations. The questionnaire and the result of the analysis of the aggregated data is in the IS/WP-2 public file.

The salient points revealed by the analysis are:

- The group owners desire to time phase the start of ATV implementation at their stations. Sixty-six per cent of the stations surveyed are expected by their owners to start implementation in the first five years following the FCC decision. Fifty-eight per cent of the stations are expected to achieve pass-through operation in the first five years.
- The group owners' estimate of the interval from implementation start to pass-through yields an average time between one and two years.
- Thirty-one per cent of the responding groups have no personnel within their groups to apply to station implementation efforts. For the remaining 69 per cent, the impact will depend strongly on the timing of station implementations. For example, only one-half person per station could be provided to support simultaneous transmitter conversions. Two people per station would be available if starts were phased as forecast by group owners.
- The results cannot be extrapolated to cover all TV stations, because the economic and labor situation differ between group-owned and independently owned or public stations.

At the time of this survey station licensees had serious misgivings about the FCC's schedule for implementing ATV. [See Section V.]

### B. Chief Engineers

A telephone survey was conducted of a random sample of television station chief engineers to obtain information about their stations' capabilities and the technical and personnel resources they have for design of both a new production facility and a new transmitter facility. The IS/WP-2 public file includes the survey questions, a compilation of the data from 93 respondents, and an analysis of the significant survey results.

*Antie*  
*7/1/92*

In analyzing the survey data, the Working Party attempted to correlate the capabilities and resources with a station size factor based upon the number of studios. No such correlation was found; stations of all sizes yielded about the same results. Efforts to find other correlated indicators were also unsuccessful. On average, there is one person per station capable of and available to do new production facility design, and slightly less than this for new transmitter facility design.

Only about 5 per cent of the stations sampled currently receive design help from their group, their owner, or from co-owned stations. Chief Engineers at 95 percent of the stations anticipated no outside help for the construction of significant new studio facilities. Their expectations for support for the design of new transmitter facilities also was negligible.

To pursue a concern that stations might not have the personnel resources to accomplish the implementation of Advanced Television, the chief engineers were asked about their current use of consultants and the potential for consultant participation in a major project. Outside consultants are currently engaged by stations for an average of 2.4 man-days per year. Thirty-nine per cent of the stations gave the names of consultants they would use for a major design project.

### C. Local Area Groups

A matter of particular concern is the availability of space on existing towers for new antennas for simulcast transmission. An early study by IS/WP-2 showed that a large percentage of stations would require new towers, even for "low power" transmission systems. The potential problem was thought to be particularly acute in some of the largest cities, where multiple-station tower facilities are often necessary.

To address the issue, IS/WP-2 established Local Area Groups in five large cities. The Local Area Groups are comprised of the chief engineers of all the television stations in each metropolitan area. Their purpose is two-fold: to help IS/WP-2 identify and understand impediments to implementation that will be peculiar to the largest cities, and to pro-actively instigate action by the stations in those areas to begin to deal with the difficulties they may face.

Among the five cities selected (Boston, New York, Chicago, San Francisco, and Los Angeles, representing nearly 25 per cent of the U.S. viewing audience), only one group (Los Angeles) indicated that it expected little difficulty in the installation of new transmission systems. This results from the particular transmission site used by nearly all broadcasters in the market. In each of the other cases, there is a decided lack of available antenna capacity (space, weight and wind loading) on existing towers, whether individual (Boston) or multi-station (New York, Chicago, San Francisco).

Explorations of innovative ways to accommodate new antennas have begun in each of the latter cities, and it is too early to tell yet whether means can be found to utilize existing facilities or whether new towers will have to be constructed. The answers to these questions will be heavily dependent upon the transmitted power levels required for the new systems. IS/WP-2 has obtained information on anticipated power levels from the proponents at its recent meeting with them. It is now preparing new instructions for the Local Area Groups to help them utilize the new data and provide further feedback to IS/WP-2 about their particular situations.

*write & update - J. Storm*

#### D. Consumer Equipment Manufacturers

Because of the importance of receiver availability in the implementation process, IS/WP-2 surveyed 15 consumer products manufacturers (ELA list) for comment on the receiver development charts and assumptions. Because of the importance of the consumer VCR in the marketplace, IS/WP-2 has also asked for comment on VCR development.

*Refer to p. 18*

*See! Summary*

#### E. Transmission System Manufacturers

The survey was conducted during the months of July and August, 1992, through a series of telephone interviews with the managers of companies that build transmitters and antennas for broadcasting applications. All six major transmitter manufacturers were interviewed and six of eight major antenna manufacturers were interviewed. Discussions included the numbers of units that are now produced by each company, the extent to which each could increase its production capacity in a reasonable manner, the relationship between power levels and production capacity, the technology expected to be used, tradeoffs in the technology, and any capacity limitations in related areas that might impact ATV implementation.

A number of antenna manufacturers provided information on installation capacities. These have to do with two principal areas: the number of crews available for such installations and the limitations imposed by weather and the seasons on the time during which installations can be accomplished.

#### F. Other ATV System Equipment Manufacturers

[To be Supplied]

#### G. Video Software Producers and Users

The survey of video software for ATV was conducted in July and August, 1992. It comprised a series of telephone interviews with the managers of major program production, post production, and distribution businesses who are most concerned with the implementation of ATV for their companies. Included in the contacts were managers at four broadcast television networks (three commercial, one public), a major subscription cable network, three Hollywood studios, one television production company, and one television post production company.

Explored during the discussions were the planning done for ATV programming, the timing of provision of the first ATV programming, the expected order of availability of programming by types, the sources of material to be produced and distributed, the expectations for installation of equipment, the minimum characteristics required for ATV programming, and expectations for technical capability in program production and distribution.

*Comparison of systems*

#### IV. Implementation Issues

During its investigations, IS/WP-2 has discovered several issues relevant to ATV implementation which impact both the timetable and the ATV system structure. Following are the most relevant of those issues.

##### A. Availability of Specific Channel Assignments

In estimating the timing of the start of broadcast ATV service, it is anticipated that the FCC will make channel assignments during the process of establishing the rules for the service. If the channel assignments are made later than the Report and Order establishing the ATV service, this will add directly to the implementation time on a month by month basis.

##### B. Dissemination of Technical Information

Equipment manufacturers on both the studio/transmitter side and the receiver side of the ATV system cannot begin design of their products until adequate technical information is available from the proponent whose system ultimately is selected. Similarly the setting of standards, both in the FCC Rules and in industry documentation, requires a high level of information transfer. The level of information provided to date by the proponents (through SS/WP-1) is inadequate for either product design or standards-setting and is sufficient only for deciding on certification and the required testing.

In its analyses of the transition scenarios and estimates of the implementation timing of the various industry segments, IS/WP-2 assumed that the required technical information will be published no later than the issuance of the NPRM proposing the system selection. Any later promulgation of the required data will add directly to the estimated time for completion of the many tasks each industry segment faces. A head start on the development and release of this information could alleviate such an impact on the implementation process.

*add reference to ATSC T3/S1 responsibility*



Timely availability of all system-specific equipment will depend on quality documentation becoming accessible quickly to those needing it. A significant effort by the selected proponent, the FCC staff, and the appropriate industry standards-setting bodies will be required if the information is to be disseminated rapidly. Technical support of other manufacturers who are impacted by the specifics of the new ATV signals will also be needed. The tasks will require a significant commitment by the selected proponent. It is likely that the same personnel developing the system designs and the demonstration hardware will subsequently be needed to prepare the documentation required of the proponent. Another consideration is that the required level of documentation very likely involves the release of proprietary information. All proponents may not be equally qualified for these tasks.

C. Impact of Assumptions on Projected Time Required  
for Implementation and Related Observations

1. Impact of Assumptions

The impact of assumptions on the projected implementation time is demonstrated by the case of the transmitter facility, which clearly is critical to the timing of the beginning of broadcast service. In order to project the time required for implementation two different sets of assumptions and charts were generated: one for a "typical" implementation scenario, and one for a "minimum" time to completion. Assumptions previously made about tasks for the ATV transition of broadcasters resulted in implementation times considered "normal" by IS/WP-2. Station channel assignment were assumed to occur later than the final Report and Order. Times estimated for completion of litigation, if needed (based on prior experience), local government approvals (at typical processing times), Federal government approvals (at anticipated processing times), and land acquisition (at typical time) were used in creating example PERT & Gantt charts for the transmitter implementation under two scenarios (existing tower and new tower).

Litigation here is assumed to include defending license challenges (if they are allowed to occur) obtaining the necessary approvals to construct facilities, and other proceeding that may accompany this new service. If allowed to proceed, litigation could have an impact on time that equals the previous point of technical information dissemination.

A second set of assumptions were developed leading to minimum implementation times, where station channel assignment was assumed coincident with the Report and Order establishing the ATV

service, no time was allowed for litigation, local government approvals were accelerated (90 days), Federal government approvals were accelerated (90 days), and land acquisition time was reduced.

The IS/WP-2 implementation studies under the two sets of assumptions project implementation times for broadcasters shown in Table i. These examples present a range of possible implementation time frames and point out that different activities can end up on the critical path with alternative underlying assumptions. For instance, in the case of a station using an existing tower, the "minimum" implementation time scenario shows that the encoder and exciter development are on the critical path. For the "typical" implementation time, these are not on the critical path.

Table 1

	New Tower Not Required	New Tower Required
Start to On-Air <sup>1</sup>	(Time in months)	
Minimum Time	16	22
Typical Time <sup>5</sup>	25	42
CP to On-Air <sup>2</sup>	(Time in months)	
Minimum Time	10 <sup>3</sup>	8
Typical Time <sup>5</sup>	16 <sup>4</sup>	12

<sup>1</sup> Start to On-Air time is from the station beginning the implementation process to the station being on the air with programming.

<sup>2</sup> CP to On-Air time is from issuance of the FCC Construction Permit to the station being on the air with ATV programming.

<sup>3</sup> Equipment availability is on the critical path.

<sup>4</sup> Local approvals are on the critical path.

<sup>5</sup> Unlike the "Typical" PERT and Gantt charts, the "Typical Time" values given here do not include time for station assignment or litigation.

## 2. Observations on the FCC's Timetable for Implementation

The studies thus confirm that the 3 year/3 year proposal contained in the FCC's decision, released 9/17/92, is reasonable in the abstract: a typical station committing to do so can be expected to be on the air within a six year cycle, including construction within a 3 - 6 year window from construction permit to on-air. In practice, however, this study and other work of IS/WP-2 suggest several additional observations:

- a. No station can be expected to complete normal construction to on-air operation within the first year, few in the second.
- b. A significant number of stations will require new antenna towers and sites.<sup>2</sup> This includes some stations in major markets, as evidenced by the Local Area Groups discussed above.
- c. Few, if any, stations will achieve the minimum time. Not all stations will achieve even the typical time. Some will encounter significant uncontrollable delays. [See Section IV.] The Commission's Rules which schedule ATV implementation should recognize and deal with this circumstance, e.g., by adjusting schedules to conform with stations' ability to convert to ATV.
- d. The FCC's proposed schedule represents a significant reduction of the time interval over which stations are expected to implement, as compared to the broadcaster expectations of time. Through survey questions posed to group owners and a sample of individual stations, IS/WP-2 has examined technical staffing and the manpower which could be made available for ATV implementation. IS/WP-2 concluded that the forecasted available stations' technical manpower could achieve pass-through capability if the station starts are time-phased over the intervals suggested by CBS and the group owners. IS/WP-2 has little confidence that the shorter schedule proposed by the Commission is realistic.
- e. The personnel requirements are far more acute for the implementation for local origination than for the studio and transmitter pass-through. Local origination requires a much greater change and expenditure, and is likely to take considerably longer.

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<sup>2</sup> IS/WP-2 Second Interim Report to Implementation Subcommittee. A survey of television stations suggests that 45 per cent may need a new tower (and some a new site), even for a "low-power" ATV implementation.

#### D. Preference for Time Phased Station Implementation

IS/WP-2's survey of station group owners show that it is in broadcasters' interests to time-phase the start of ATV station implementation, initially providing pass-through capability.

A similar approach, in which increasing numbers of stations started the transition process beginning with stations in the major markets, was adopted in the CBS study.

The staggering of implementations anticipated by both CBS and the group owners surveyed (even accepting what some see as the optimistic views of CBS and the group owners about implementation time) would result in approximately 50% of the stations reaching pass-through after 5 years.

The time restrictions proposed in the Second NPRM and succeeding announcement of 9/17/92 would preclude much of the time-phasing of station conversions desired by the broadcasters surveyed and suggested by CBS. The FCC's shortening of the implementation cycle will lead to the loss of some important benefits that would accrue from the staged approach. Specifically, it will:

- increase capital demands on groups, due to simultaneous construction;
- negate some of the equipment cost reductions forecasted by CBS and SS/WP-3, since design refinement and productivity increase require both time and work, not merely higher volume; and
- exaggerate the problem of financing the on-air operations of some stations, since the earlier the start, the smaller the audience.

### E. Availability of Consumer Products

IS/WP-2's study of ATV consumer receivers projects general market availability 3 years after the release of full technical information (assumed to be coincident with the Third NPRM proposing a system selection) and 2-3 years after the Report and Order authorizing the ATV broadcast service. Even though a proponent/manufacturer whose system is selected as the U.S. standard could have a 6-9 month advantage over this development time. However, it is more likely that consumer acceptance and significant market growth will be contingent upon the availability of receivers from a variety of manufacturers.

The development cycle is thought to be representative of a major new technological product involving several iterations of large scale, custom integrated circuit (IC) development. A manufacturer choosing to purchase, rather than develop, the semiconductor content would not have a significant time advantage. The ICs would still have to be developed. The prospective purchaser would still lack the application experience and head start gained by a receiver manufacturer/developer through several iterations of design.

The implementation cycle for consumer products is of equal importance to that for getting broadcast transmitters on the air and can affect the work and conclusions of the Commission and of other Working Parties of the Advisory Committee. Some have projected that ATV receiver penetration will be seeded by demand for receivers stimulated by other media, before availability of terrestrial ATV broadcasting. The scenario developed to date by IS/WP-2 for availability of technical information and standards and subsequent development of receivers does not support such a projection.

## F. Availability Of Transmission System Equipment

### Transmitters

The capacity of the industry to build transmitters depends upon the power level involved. At the 30 KW level, current (NTSC) production capacity is approximately 250 transmitters per year. At higher power levels, the number reduces to about 175. At the 10 KW level, it increases to almost 300 transmitters per year. Actual sales are considerably lower than these numbers.

When considering the move to ATV, a number of assumptions are made by the manufacturers. First, it is assumed that the technology required in transmitters is comparable to that needed for NTSC. Second, it is assumed that the transmitter power levels required for ATV will be in the region of 30 KW or less. Many installations will require lower power, and few will require higher power. Third, it is assumed that the vast majority of transmitters required will be UHF.

Additional factors involved in the planning by the transmitter manufacturers derive from their assessments of the marketplace and the needs of their customers, the broadcasters. There is some expectation that not all broadcasters will choose to implement ATV, with certain estimates running as high as half of stations deciding not to proceed with ATV. There is also an expectation that most stations will build single-ended, as opposed to redundant, transmitter plants during the initial phases of implementation, thereby keeping the number of transmitters required at or below the current number of stations.

If no efforts were made to increase production capacity, manufacturers could deliver ATV transmitters at the rate the current capacity can support, i.e. 175-300 transmitters per year depending upon power levels. But manufacturers reported planning increased capacity for the period when high volume production will be needed. To some extent, such planning calls for the construction of additional facilities. To a much greater extent, it involves the addition of a second shift for the period of heavy production. No shortage of the skilled personnel needed to implement either approach was foreseen. None of the manufacturers foresaw any shortage of components for the construction of transmitters.

With the increases planned, industry capacity to build transmitters rises to approximately 550 per year on a sustainable basis at the 30 KW level. It is possible to surge past this to a level of about 750 per year, but this was considered by the manufacturers as practical only for a fairly short time. At the 10 KW level, the sustainable capacity is on the order of 700 transmitters per year. The aggregate capacity divides over the various power levels; the capacities for 10 and 30 KW cannot be added. At power levels in the region from 1-5 KW, additional capacity does become available that can be added to the quantities producible at the higher power levels.

An important consideration in turning the gross production capacity of the industry into transmitters delivered during the required interval is the early planning and placing of orders by broadcasters. Some of the manufacturers expected lead times for transmitters to extend to two years from the current four months. This means that the last of the transmitters to be installed within the five year window must be ordered about nine months into the three-year construction period, allowing on the order of three months for installation.

#### Antennas

It is the transmitter power level that determines manufacturing capacity, with 30 KW into the antenna once again appearing to be a break point. The current capacity of the industry to manufacture antennas is almost 250 per year at power levels of 30 KW and up. Below that level, capacity jumps to over 350 per year. Actual sales are currently well below capacity.

For production of antennas for the transition to ATV, manufacturers can increase their capacities, some by a factor of two. This results in a domestic industry-wide capability of about 475 antennas per year at the 30 KW power level and above. Below 30 KW, capacity can be increased to around 600 units per year. These levels can be supplemented with imported antennas, from other manufacturers, as needed by the broadcast industry.

Various factors are cited by the manufacturers in estimating their production capacities. Consideration must be given to whether antennas are top mount, side mount, or wrap-around. It is generally agreed that wrap-around, or panel, antennas are easier to manufacture than top or side mount versions. Conversely, installation of panel antennas takes about twice as long as for top or side mount units.

The number of antennas required will be affected by the number of locations where broadcasters work together to build common facilities and use common antennas. Panel antennas in particular are

useful across a broad part of the UHF spectrum. Their use will allow multiple stations to share antennas. The number of stations possible per such antenna will be determined as much or more by the transmission line design and any required power combiners and splitters as by the antenna itself. Some manufacturers expect broadcasters to start out with individual antennas on their own towers at lower than permitted power levels, then to switch to common facilities and shared antennas later while increasing power to the maximum authorized.

There is disagreement among the manufacturers regarding the impact of the relationship between peak and average power. Some feel that the transmission lines and power combiners and splitters will be limited only by the heating effects of the average power levels. Others believe that peak power will have a significant impact on voltage breakdown requirements, pointing out that voltage breakdown leads to an avalanche effect that can destroy equipment. Of considerable importance is the derating required in multiple station installations to account for the possibility that all stations might on occasion reach their peak powers simultaneously, thereby creating much higher voltages than normally appear in the system.

Yet another area requiring attention is the choice of coaxial or waveguide transmission lines. The impacts of this selection are on wind loading, power handling capacity vs. frequency, transmission line bandwidth, and transmission line losses. These issues become of increasing significance in multi-station installations.

#### Tower and Installation Considerations

There are three companies that manufacture towers for broadcast use (1,000 feet and up). There are about six companies that can erect such towers up to 1,500 feet. Three of these can erect beyond 1,500 feet. The same companies that erect towers are needed to make any structural changes such as reinforcements that are required. There are about twenty companies that can handle change-outs and new installations of antennas and transmission lines only, without involving structural work on the tower. Some of these companies have multiple crews.

Using all the assumptions stated in the appendices, in one year twelve towers up to 2,000 feet can be built or reinforced, thirty-five additional towers up to 1,000 feet can be built or reinforced, and 347 antennas can be installed. Installation of the antennas is assumed to be accomplished with different crews than build or reinforce the towers in order to maintain maximum capacity for tower construction. The number of antennas installed in a year can probably



be increased by shifting the percentage of time the crews devote to television broadcast vs. other clients. If this number can be moved up to 600 per year and installations can be uniformly spread over the three-year period, the need can be met. It should be noted that provision is made in this analysis only for the installation of new antennas; any rearrangement of existing equipment will necessarily reduce the number of antennas that can be installed by increasing the work and time required.

Not so easy of solution is the shortfall in tower installation and reinforcement crews. Even if they were to devote full time to television broadcast installations, there is capacity for building or reinforcing only twenty-four towers up to 2,000 feet and seventy towers up to 1,000 feet each year. Since estimates are that twenty-five to fifty per cent of stations will require either a new tower or tower reinforcement to accommodate ATV, there is a significant shortfall in capacity. In the three year construction window, a total of about 300 towers can be built or reinforced if the crews devote full time to broadcast television and the work is spread uniformly, while between 450 and 900 will require work of this sort. Even if the calculations of construction/reinforcement capability are off by a factor of two, clearly, some stations are likely not be able to get their tower and antenna work done within the three year window. IS/WP-2 believes that the Commission can expect to receive requests for extensions of time to construct that will result in these instances.

\*\*\*\*\* Alternate F. per Wilk

F. Availability Of Transmission System Equipment

Of the three subsections below -- transmitters, antennas, and towers and installation, only the latter is a critical path item which could jeopardize operational schedules. These subsections are based on IS/WP-2 surveys of manufacturers and others in mid-1992.

1. Transmitters

The ability of U.S. manufacturers to build and install the projected types and quantities of transmitters within the FCC's current time frame for ATV implementation cannot be assessed with confidence, but may be marginally adequate, provided a few important conditions are met by manufacturers and broadcasters. This conclusion is based on projections of aggregate transmitter requirements.

One of the key conditions that broadcasters will have to meet is early planning and ordering of transmitters. Some manufacturers expect lead times to extend from the current average of four months to about two years from the date of an order. Installation time may require